UNIVERSITY OF VIRGINIA
DIGITAL LOGIC DESIGN
STUDIO ASSIGNMENT 7

Standard honor statement. Your design & implementation should be your own work.

OBJECTIVE

This studio assignment tasks you to design a simple controller. You will define the interfaces and coding schemes and implement the FSM, encoders and decoders to process the inputs and produce the outputs.

PROBLEM DESCRIPTION

You are to design a gumball machine controller. The gumball machine accepts nickels, dimes, and quarters, one coin at a time. When a coin is entered, a "coin detector" sets the appropriate input to 1 for one clock cycle, otherwise all inputs are 0. A single gumball costs $0.20. When $0.20 or more has been entered, a gumball is released, along with the appropriate change.

PRE-WORK

1. Define the interface between the FSM controller and the rest of the candy machine. State the requirements clearly, and encode the coin inputs and gum/change outputs to minimize the number of FSM inputs and outputs. Derive the state transition diagram for a Moore FSM.
2. Design each component (encoder, FSM, and decoder) separately and implement them in *Logisim*. Test each component separately before trying to connect them together. Use D flip-flops for the FSM.
3. After you are confident that each component is working properly, connect them in *Logisim* to create a complete system.
4. Be sure that your design is complete and well documented. All inputs and outputs must be clearly labeled. Use the "label" attribute rather than a text box.
5. Optional: Try implementing the FSM with T flip-flops.
6. Optional: Try implementing the FSM as a Mealy machine.

IN STUDIO

Bring your completed *Logisim* file and your documented design procedure to the studio to be reviewed by your studio instructor. Be prepared to answer questions about your design and make suggested changes to demonstrate understanding.

NOTES

As the designer, you decide what your gumball machine will do if a user deposits $0.40. You can either give 2 gumballs or give $0.20 change. Document this decision. Your decision on this point impacts the candy release mechanism and change return mechanism.

Define your output variables (which are the inputs to the candy release mechanism and to the change mechanism) very clearly. You will almost certainly need more than one bit to represent the "change" output.

GRADING SCALE

- 1 point for including a block diagram with clearly defined interfaces (i.e., inputs and outputs)
- 2 points for correctly designing and implementing the input encoder
- 2 points for correctly designing and implementing the output functions and decoder
- 2 points for correctly designing and implementing the FSM
- 2 points for answering questions posed by your studio instructor
- 1 point for professionalism, including a well-documented design process